United States Environmental Protection Agency | Air and Radiation 6202J | Draft November 1998

EPA Coalbed Methane Outreach Program Technical Options Series

GENERATING ELECTRICITY WITH COAL MINE METHANE-FUELED MICRO TURBINES

TurboGenerator™ Power System, photo courtesy of AlliedSignal

MicroTurbine™, photo courtesy of Capstone

Micro turbines are about a third the size of comparable diesel generators

APPLICATIONS AND BENEFITS INCLUDE...

- Off-grid self-generation of electricity at remote gas production sites
- Available in 30 kW to 2000 kW systems
- Use with cogeneration technologies such as discharge heat recovery
- Low air and noise emissions
- Low installation and maintenance costs
- Ideal for gob gas use, as they can operate on gas with a heating value as low as 350 Btu
- Recovery and use of methane reduces greenhouse gas emissions

Micro turbines have only one moving part, which drastically reduces maintenance

Why Consider Using Micro Turbines To Generate Electricity With Coal Mine Methane?

A large portion of the methane emitted from coal mines comes from gob areas (collapsed rock over mined out coal), where methane concentrations typically vary from 30 to 80%. Gas with a methane concentration less than 95% is usually not suitable for pipeline injection. Coal mines frequently do not use medium-quality gas from gob wells and instead vent the gas to the atmosphere, contributing to global warming. However, gas with a methane concentration exceeding 35% can in fact be used as a fuel for on-site electricity generation. Given their large energy requirements, coal mines can recover methane and generate electricity with micro turbines to realize significant economic savings and reduce greenhouse gas emissions.

The micro turbine is a new technology developed from the aerospace industry that may be an ideal option for on-site electricity generation at coal mines. The micro turbine consists of a small, air-cooled gas turbine connected to a high-speed generator and compressor on a single shaft. This simple design results in a system with a high power output, minimal noise generation, and efficient operation. Diesel, gasoline or kerosene can be used as alternate fuels to insure continuous electricity production in the event that the methane supply is disrupted.

Micro turbines use air-bearing technology that eliminates the need for lubricants

Micro turbines are a compact, quiet, clean, and reliable power source. Their compact size allows them to be located at remote gob well sites or inside mine buildings, and can reduce the level of investment and maintenance typically associated with conventional generators. Because the generating capacity can be sized from 30 kW to 2000 kW by integrating multiple-unit systems, a mine can easily scale the project according to its needs. The micro turbine's 22-30% efficiency rating improves with the use of exhaust heat for pre-heating and adsorptive cooling.

Currently, two manufacturers, Capstone Turbine Corp. and AlliedSignal Power Systems Inc. state that micro turbines will be available by late 1998. Advertised uses for micro turbines include off-grid power generation, load management, standby power generation, and cogeneration. According to projections from AlliedSignal and Capstone, installed costs for micro turbines will range from $US 350/kW to $700/kW.

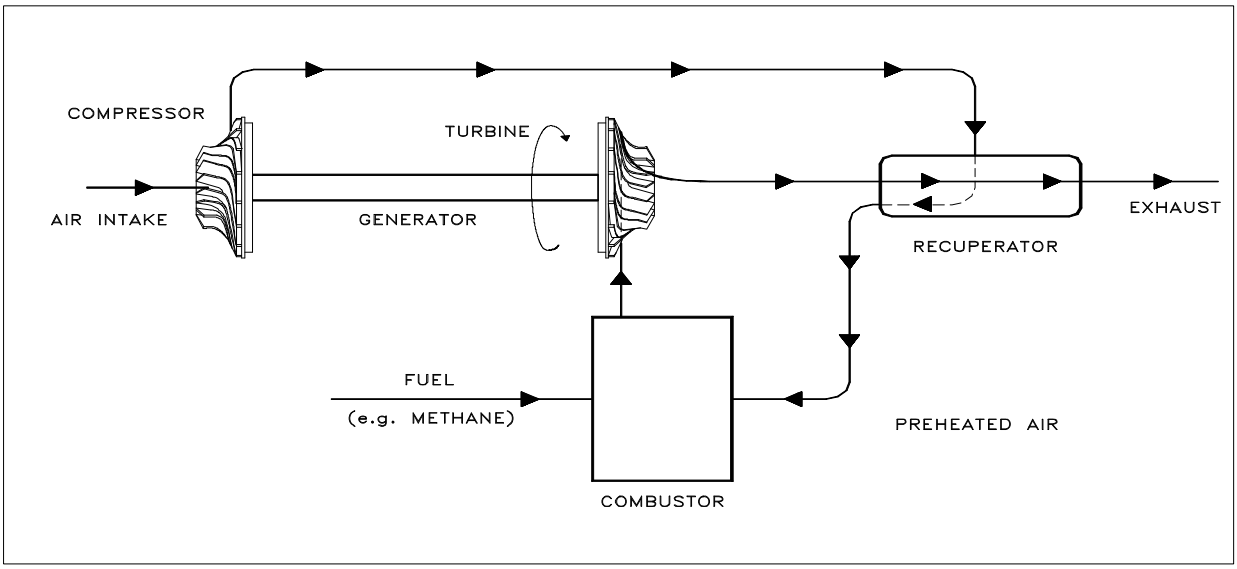
Facts About Micro Turbine Power Plants...

- Provide off-grid power to remote areas
- Exhaust temperatures for a single 30 kW system exceed 500° F with an air flow of 35.2 lb (16.0 kg) per minute; a 75 kW system has a 470° F exhaust temperature and an air flow of 91.2 lb (41.5 kg) per minute
- Mines can recover exhaust energy over 250,000 Btu/hr for heating or drying
- Quiet operation (at least one model is less than 60 decibels @ 33 feet)
- Multi-unit systems can be designed according to site-specific power demands
- Natural gas, diesel, gasoline or fuel oil can be used as a backup fuel

Micro turbines have a high power-to-weight and volume ratio compared to diesel generators

In today's changing power market, the trend toward distributed generation will allow consumers to determine their own power generation sources. At coal mines, these mini power plants can help shift the source of power from centralized power stations to on-site units, satisfying a host of power-generating needs. Micro turbines are both a short and long term solution to meeting a coal mine's electricity needs, while reducing greenhouse gas emissions.

How A Micro Turbine Operates



A micro turbine is a small, recuperated combustion turbine that operates with a high-speed generator, compressor and turbine located on the same shaft. Pressurized gas is preheated with turbine exhaust increasing the overall efficiency of the system. Benefiting from new technology, the core unit operates on floating air bearings eliminating the need for oil lubrication or cooling systems.

Comparison Of Micro Turbine With Other Power Generation Technologies

	MICRO TURBINE	IC ENGINE	FUEL CELL	GAS TURBINE
Capacity (kW)	30-2000	10-4000	3-3000	1000-50000
Efficiency	22%-30%	12%-20%	40%-65%	21%-42%
Typical Installed Cost ($US/kW)	350-700	600-1000	900-3000	650-1000
Maintenance cost ($US/kW-h)	0.003-0.01	0.015-0.025	0.005-0.01	0.003-0.008

For More Information...

Rapidly changing electricity markets are creating new opportunities for on-site power generation using coal mine methane. Micro turbines may be a cost-effective power generation option for gassy underground coal mines.

To obtain more information about generating
electricity using micro turbines contact:

AlliedSignal Power Systems Inc.
2525 W. 190th Street
Torrance, CA 90504-6099
Telephone: (800) 406-2267
Fax: (310) 512-1561
e-mail: turbogen@alliedsignal.com
Web site: www.alliedsignal.com/turbogen

Capstone Turbine Corp.
6025 Yolanda Avenue
Tarzana, CA 91356
Telephone: (818) 774-9600
Fax: (818) 774-0228
Web site: www.capstoneturbine.com

Or contact EPA's Coalbed Methane Outreach Program for information about this and other profitable uses for coal mine methane:

Coalbed Methane Outreach Program
U.S. EPA (6202J)
401 M Street , SW
Washington, DC 20460 USA
(202) 564-9468 or 564-9481
Fax: (202) 565-2077
e-mail: fernandez.roger@epa.gov
schultz.karl@epa.gov

http://www.epa.gov/coalbed

EPA
COALBED
METHANE
OUTREACH
PROGRAM

The mention of products or services in this case study does not constitute an endorsement by EPA.